

WHAT IS CLAIMED IS:

1. An adhesive formed from a composition comprising, based on 100 weight percent of the resin portion of the composition:

5 about 5 to about 50 weight percent of a poly(arylene ether) resin having a number average molecular weight of about 8,000 to about 13,000;

about 50 to about 90 weight percent of a thermosetting resin;

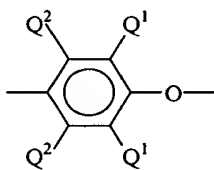
about 0.5 to about 15 weight percent of a toughening agent; and

about 0.1 to about 7 weight percent of a cure agent.

10 2. The adhesive of Claim 1 wherein the poly(arylene ether) resin has a number average molecular weight of about 9,000 to about 12,000.

3. The adhesive of Claim 1 wherein the poly(arylene ether) resin has a number average molecular weight of about 10,000 to about 11,000.

4. The adhesive of Claim 1 wherein the poly(arylene ether) resin comprises a plurality of structural units of the formula (I):



(I)

15 wherein for each structural unit, each Q¹ is independently halogen, primary or secondary lower alkyl having up to about 7 carbon atoms, phenyl, haloalkyl, aminoalkyl, hydrocarbonoxy, or halohydrocarbonoxy wherein at least two carbon atoms separate the halogen and oxygen atoms; and each Q² is

20 independently hydrogen, halogen, primary or secondary lower alkyl having up to 7 carbon atoms, phenyl, haloalkyl, hydrocarbonoxy or halohydrocarbonoxy wherein at least two carbon atoms separate the halogen and oxygen atoms.

5. The adhesive of Claim 4 wherein each Q¹ is an alkyl group having from 1 to 7 carbon atoms, and each Q² is hydrogen.

6. The adhesive of Claim 4 wherein the poly(arylene ether) is a homopolymer comprising 2,6-dimethylphenylene ether units, or a random
5 copolymer comprising 2,6-dimethylphenylene ether units in combination with 2,3,6-trimethyl-1,4-phenylene ether units.

7. The adhesive of Claim 1, wherein the thermosetting resin is selected from the group consisting of cyanate esters, polyesters, epoxy, benzoxazines, benzocyclobutene resins, and mixtures comprising at least one
10 of the foregoing thermosetting resins.

8. The adhesive of Claim 7, wherein the thermosetting resin is an epoxy resin comprising the condensation product of a bisphenol polyglycidyl ether and a bromine-substituted bisphenol.

9. The adhesive of Claim 7, wherein the epoxy is the reaction
15 product of tetrabromobisphenol A and the diglycidyl ether of bisphenol A or bisphenol F, the reaction product having an average of at most one aliphatic hydroxy group per molecule, and the reaction product comprising about 10 to about 30 weight percent bromine as aryl substituents.

10. The adhesive of Claim 7, wherein at least one halogen-free
20 epoxidized novolac is present.

11. The adhesive of Claim 1, wherein the thermosetting resin comprises a cyanate ester.

12. The adhesive of Claim 11, further comprising a brominated
flame retardant.

13. The adhesive of Claim 1, wherein the thermosetting resin
25 comprises a polyester.

14. The adhesive of Claim 1, wherein the thermosetting resin comprises a benzoxazine.

15. The adhesive of Claim 1, wherein the thermosetting resin comprises a benzocyclobutene resin.

5 16. The adhesive of Claim 1, wherein the thermosetting resin comprises an epoxy and a cyanate ester.

Sub A9 17. ~~The adhesive of Claim 16, further comprising a brominated flame retardant.~~

10 18. The adhesive of Claim 1, wherein the thermosetting resin comprises a cyanate ester and an epoxy, the epoxy comprising the condensation product of a bisphenol polyglycidyl ether and a bromine-substituted bisphenol.

19. The adhesive of Claim 1, wherein the toughening agent is a polyvinyl butyral.

15 20. The adhesive of Claim 19, wherein the polyvinyl butyral is present at 1 to 15 weight percent of the total composition solids.

Sub A10 21. ~~The adhesive of Claim 19, wherein the toughening agent is styrene-butadiene-styrene block co-copolymer.~~

20 22. The adhesive of Claim 1, further comprising a plasticizer effective for poly(arylene ether) polymers.

23. The adhesive of Claim 22, wherein the plasticizer is resorcinol diphosphate, bisphenol A diphosphate or isopropylated phenol phosphates.

24. The adhesive of Claim 1, further comprising one or more of modifiers, fillers, antioxidants, UV absorbers, stabilizers, lubricants, plasticizers, pigments, dyes, colorants, anti-static agents, and flame retardants.

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25. The adhesive of Claim 1, comprising:

about 20 to about 40 weight percent of the poly(arylene ether)
resin;

about 52 to about 80 weight percent of the thermosetting resin;

5 about 3 to about 10 weight percent of toughening agent; and

about 0.1 to about 7 weight percent of the cure agent.

26. The adhesive of Claim 1, comprising:

about 25 to about 35 weight percent of the poly(arylene ether)
resin;

10 about 55 to about 65 weight percent of the thermosetting resin;

about 4 to about 8 weight percent of the toughening agent; and

about 0.1 to about 1 weight percent of the cure agent.

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27. An adhesive formed from a composition comprising, based on
100 weight percent of the resin portion of the composition:

15 about 5 to about 50 weight percent of a poly(arylene ether)
resin, wherein the poly(arylene ether) has a number average molecular weight
of about 8,000 to about 13,000, and wherein the poly(arylene ether) is the
reaction product of a higher molecular weight poly(arylene ether) with a
peroxide and, optionally, a phenolic compound;

20 about 50 to about 90 weight percent of a thermosetting resin;

about 0.5 to about 15 weight percent of a toughening agent; and

about 0.1 to about 7 weight percent of a cure agent.

28. A laminate comprising:

a thermoplastic substrate;

a conductive metal foil at least partially disposed on at least one side of the substrate; and

5 an adhesive disposed between the substrate and the metal foil, wherein the adhesive is formed from a composition comprising, based on 100 weight percent of the resin portion of the composition:

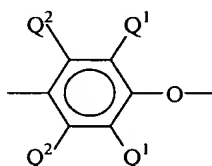
about 5 to about 50 weight percent of a poly(arylene ether) resin having a number average molecular weight of about 8,000 to about 13,000;

10 about 50 to about 90 weight percent of a thermosetting resin;

about 0.5 to about 15 weight percent of a toughening agent; and

about 0.1 to about 7 weight percent of a cure agent.

29. The laminate of claim 19, wherein the poly(arylene ether) resin comprises a plurality of structural units of the formula (I):



(I)

15 wherein for each structural unit, each Q¹ is independently halogen, primary or secondary lower alkyl having up to about 7 carbon atoms, phenyl, haloalkyl, aminoalkyl, hydrocarboxy, or halohydrocarboxy wherein at least two carbon atoms separate the halogen and oxygen atoms; and each Q² is

20 independently hydrogen, halogen, primary or secondary lower alkyl having up to 7 carbon atoms, phenyl, haloalkyl, hydrocarboxy or halohydrocarboxy wherein at least two carbon atoms separate the halogen and oxygen atoms.

30. The laminate of claim 28, wherein the thermosetting resin is selected from the group consisting of cyanate esters, polyesters, epoxy, benzoxazines, and benzocyclobutene resins.

31. The laminate of claim 30, wherein the epoxy is a condensation product of a bisphenol polyglycidyl ether and a bromine-substituted bisphenol.

32. The laminate of claim 28, wherein the toughening agent is a polyvinyl butyral or a styrene-butadiene-styrene block co-copolymer.

33. A method for forming a laminate comprising:

coating a surface of a thermoplastic or metalized thermoplastic or conductive metal foil with an adhesive comprising, based on 100 weight percent of the resin portion of the composition:

about 5 to about 50 weight percent of a poly(arylene ether) resin having a number average molecular weight of about 8,000 to about 13,000;

about 50 to about 90 weight percent of a thermosetting resin;

about 0.5 to about 15 weight percent of a toughening agent; and

about 0.1 to about 7 weight percent of a cure agent; and

applying the adhesive against a first surface of a thermoplastic substrate.

34. The method of claim 33, further comprising partially curing the adhesive prior to applying the adhesive against the substrate.

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35. A method for forming an article, comprising:

coating a surface of a thermoplastic substrate with an adhesive comprising, based on 100 weight percent of the resin portion of the composition:

- 5 about 5 to about 50 weight percent of a poly(arylene ether) resin having a number average molecular weight of about 8,000 to about 13,000;
- about 50 to about 90 weight percent of a thermosetting resin;
- 10 about 0.5 to about 15 weight percent of a toughening agent;
- about 0.1 to about 7 weight percent of a cure agent; and
- applying the adhesive against a surface of an adherend.

36. An adhesive formed from a composition comprising, based on 15 100 weight percent of the resin portion of the composition:

- about 5 to about 50 weight percent of a poly(arylene ether) resin having a number average molecular weight of about 8,000 to about 13,000;
- about 50 to about 90 weight percent of a thermosetting resin;
- and
- 20 about 0.1 to about 7 weight percent of a cure agent.

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